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## MISCELLANEOUS.

130. Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy in Defiance College, Defiance, Ohio.

From a cloud of angular elevation  $\phi=45^\circ$ , a streak of lightning darted to the earth. The temperature of the atmosphere was  $t=80^\circ$ , and the percentage of humidity  $p=90$ . After  $m=3$  seconds, the report of the stroke at the earth was heard. How far away from the observer did the streak of lightning (1) start, and (2) strike the earth?

Solution by G. B. M. ZERR, A. M., Ph.D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

Let  $H$ =tension of aqueous vapor at  $t=80^\circ$ .

Let  $H'$ =tension of aqueous vapor at dew point.

Then  $(H'/H)100=p=90$ ,  $80^\circ F=26^\circ .7C$ .

Now  $H=26.045\text{mm}$ .  $\therefore H'=\frac{9}{10} \text{ of } 26.045\text{mm.}=23.4405\text{mm.}$

Let us take the barometric pressure at  $740\text{mm.}=P$ .

Then  $740\text{mm.}-23.4405\text{mm.}=716.595\text{mm.}$  will represent the pressure of dry air.

Let  $W$ =weight of litre of dry air at  $80^\circ F$ .

$W'$ =weight of vapor in one litre.

$$W=1.293187 \times \frac{716.5595}{760} \times \frac{1}{1+.00367 \times 26.7}=1.110667 \text{ grams.}$$

$$W'=1.293187 \times .6235 \times \frac{23.4405}{760} \times \frac{1}{1+.00367 \times 26.7}=.022653 \text{ grams.}$$

$W+W'=1.13332$  grams=total weight of litre.

$V=\sqrt{(Pk/\rho)}$ , where  $k=1.41$ =ratio of specific heat of air at constant pressure to the specific heat at constant volume.

$P=740\text{mm.}=986634$  dynes per square cm.,  $\rho$ =density=.00113332.

$\therefore V=\sqrt{[(986634 \times 1.41)/.00113332]}=350.36$  meters per second.

$3 \times 60 \times 350.36=63.0648$  kilometers=distance of observer from point on earth where lightning strikes. If we regard the distance as a straight line, then distance to cloud= $63.0648\sqrt{2}=89.18624$  kilometers.

If we regard the earth as a sphere, diameter  $6370.946$  kilometers, then  $1^\circ=111\frac{1}{4}$  kilometers. Therefore  $34' 3.3''=63.0648$  kilometers.

$$\text{Distance to cloud}=\frac{6370.946 \sin(34' 3.3'')}{\sin(44^\circ 25' 56.7'')}=91.4594 \text{ kilometers.}$$

131. Proposed by SAUL EPSTEEN, Ph. D., The University of Chicago.

Find a power series for  $\pi^{nx}$  ( $n$ =any integer).

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

$$\pi^{nx}=1+nx\log_e\pi+\frac{n^2x^2}{2!}(\log_e\pi)^2+\frac{n^3x^3}{3!}(\log_e\pi)^3+\dots$$